

Amendments To The Specification

[0002] Please replace the paragraph beginning at page 1, line 10 with the following rewritten paragraph:

This invention relates generally to computer I/O subsystems having peripheral bus segments, and more particularly to a device and method for resetting bus segments in I/O subsystems that are segmented with expanders.

[0003] Please replace the paragraph beginning at page 4, line 3 with the following rewritten paragraph:

During the operation of the I/O subsystem, however, an SCSI device may not function properly and hang the SCSI bus. For example, the SCSI device 206A may malfunction while accessing the bus segment 210 and continue to assert BSY signal on the bus segment 210. Because the expander 214 repeats the BSY signal onto the other bus segment 208, the SCSI device 206A hangs the entire I/O subsystem, thus preventing other devices from accessing the bus segments.

[0004] Please replace the paragraph beginning at page 4, line 9 with the following rewritten paragraph:

When the SCSI bus is hung, the conventional SCSI protocols typically provide a reset signal RST to reset the bus devices. For example, the host computer 202 may issue a RST signal over SCSI bus segment 208 to the devices 206A and 206B. In this case, however, the expander also causes the RST signal to propagate to all devices 212A and 212B in the I/O subsystem 200 and cause those devices to reset due to the repeating function of the expander 214. Thus, all devices and expanders in the I/O subsystem will be reset.

[0005] Please replace the paragraph beginning at page 5, line 1 with the following rewritten paragraph:

The present invention fills these needs by providing an expander device and method for resetting bus segments to clear bus hang in an I/O subsystem segmented with expanders. It should be appreciated that the present invention can be implemented in numerous ways, including as a process, an apparatus, a system, a device, a method, or a computer readable medium. Several inventive embodiments of the present invention are described below.

[0006] Please replace the paragraph beginning at page 6, line 17 with the following rewritten paragraph:

In yet another embodiment, the present invention provides an SCSI expander for resetting bus segments to clear bus hang in an SCSI I/O subsystem. Each bus segment includes a set of devices and a bus that is coupled to the set of devices. The SCSI expander is arranged to couple a first bus in a first bus segment and a second bus in a second bus segment. The SCSI expander is further configured to repeat communication signals by receiving the communication signals from one SCSI bus segment and outputting the communication signals to the other SCSI bus segment. The SCSI expander includes a first SCSI I/O interface circuit, a second SCSI I/O interface circuit, and an SCSI expander controller. The first SCSI I/O interface circuit is adapted to interface communication signals with the first SCSI bus segment. The second SCSI I/O interface circuit is adapted to interface the communication signals with the second SCSI bus segment. The SCSI expander controller is coupled to

communicate the communication signals between the first and second SCSI I/O interface circuits and is arranged to control communication between the first and second SCSI bus segments. The SCSI expander controller includes a reset rest and segment isolation segment controller adapted to isolate a reset signal received on the first bus segment from propagating to the second bus segment. The SCSI expander controller isolates all communication signals to prevent propagation of the communication signals between the first and second bus segments after isolating the reset signal until the second bus is in a BUS FREE state.

[0007] Please replace the previously amended paragraph beginning at page 8, line 22 with the following rewritten paragraph:

The present invention provides an expander device and method for resetting bus segments in an I/O subsystem segmented with expanders. It will be obvious, however, to one skilled in the art, that the present invention may be practiced without some or all of these specific details. In other instances, well known process operations have not been described in detail in order not to unnecessarily obscure the present invention.

[0008] Please replace the previously amended paragraph beginning at page 10, line 21 with the following rewritten paragraph:

With continuing reference to Figure 3, during operation of the I/O subsystem 300, a peripheral device in the I/O subsystem 300 may not function properly and “hang” the bus connected to the device. In an SCSI I/O subsystem,

for example, the peripheral device 320 in bus segment 312 may malfunction and hang the bus 332 by asserting and continuing to assert “BSY” signal, which indicates that the bus is being used and thus is not available for other devices. The continued assertion of the BSY signal prevents the buses 330, 332, and 334 from entering BUS FREE state, which indicate that a bus is available for arbitration. Because the expanders 304 and 306 propagate all signals to bus segments 310 and 314, the BSY signal will propagate to all the buses 330, 332, and 334. The propagated BSY signal prevents all devices including the host computer 302 and other properly operating peripheral devices from arbitrating for the bus. In so doing, all buses ~~bus segments~~ 330, 332, and 334 are hung and the operation of the entire I/O subsystem 300 comes to a standstill.

[0009] Please replace the paragraph beginning at page 11, line 20 with the following rewritten paragraph:

In this segment isolation mode, each expander on the bus segment of the reset issuing device examines the other bus segment (i.e., far-side bus segment) to determine if the other bus (i.e., far-side bus) is BSY. If the far-side bus is not BSY, the device causing the hang condition must have been in the same bus segment associated with the reset issuing device. Because all devices on the reset issuing segment have already been reset to clear the BSY signal, the hang condition has been resolved and the expander exits segment isolation mode. On the other hand, if the far-side bus is BSY, a far-side reset is issued to the other bus segment to reset all devices and computers in the other bus segment. In this case, the bus segments in the I/O subsystem 300 are reset one bus segment at a time by repeating the above

process, proceeding from the bus segment of the reset issuing device (i.e., near-side segment) to the most distant bus segment in the I/O subsystem 300.

[0010] Please replace the paragraph beginning at page 13, line 16 with the following rewritten paragraph:

The SCSI controller 402 is coupled receive and/or output data and control signals to and from the buffers 410, 412, 410A, 412A, 420, 422, 420A, and 422A in the I/O interfaces 404 and 406 and is adapted to provide control functions for the expander 304 318. During normal operating mode, the input buffers 410 and 422 operate to drive input signals for output through output buffers 420 and 412, respectively, so that communication signals received on one bus segment are is propagated onto the other bus segment. For example, when a signal is received from the bus 330, the input buffer 410 drives the signal onto the SCSI controller 402. The SCSI controller 402 then provides the signal to the output buffer 420, which drives the signal onto the bus 332. On the other hand, the input buffer 422 drives a signal received from the bus 332 onto the SCSI controller 402, which provides the signal to the output buffer 412. The output buffer 412 then drives the signal onto the bus 330. In this manner, the expander 304 repeats signals received on one bus segment to the other bus segment.

[0011] Please replace the previously amended paragraph at page 14, line 23 with the following rewritten paragraph:

The reset and segment isolation controller 408 is also arranged to generate a

segment isolation signal ISOLATE for isolating bus segments 310 and 312 from one another. Specifically, the segment isolation signal ISOLATE is provided to disable the output buffers 412 and 422 in the I/O interfaces 404 and 406 so that all signals received on one bus segment are ~~is~~ not propagated to the other bus segment. By preventing signal propagation between SCSI buses 330 and 332, the expander 304 effectively isolates the bus segments 310 and 312. Segment isolation techniques are described in more detail in U.S. Patent Application No. 09/846,975, entitled "Expander Device and Method for Isolating Bus Segments in I/O Subsystem," which is incorporated by reference.

[0012] Please replace the paragraph beginning at page 16, at line 5 with the following rewritten paragraph:

With continuing reference to the method 500 in Figure 5, when a bus hang occurs, a host computer 302 asserts a reset signal RST_A on its own bus segment 330 in operation 502. In response to the reset signal RST_A, the expander 304 and all devices 316 and 318 on the bus segment 330 reset in operation 504. The resetting of all devices in bus segment 330 causes the BSY signal on the bus 330 to clear and the bus 330 will be in BUS FREE state. In addition, the expander 304 enters into a reset isolation mode by issuing RST_ISOLATE signal to the output buffers 412A and 420A. This prevents the reset signal from propagating to other bus segments 312 and 314. It should be noted that if the device that caused the bus hang condition is located in the bus segment 312, the resetting of the bus segment 312 will clear the bus hang condition throughout the entire I/O subsystem 300. Accordingly, other bus segments 312 and 314 will not need to be reset with

attendant savings in reset time and system resources.

[0013] Please replace the previously amended paragraph beginning Page 17, at line 3 with the following rewritten paragraph:

After exiting the segment isolation mode, the host computer 302 on near-side segment selects the expander 304 to determine if the far-side bus 332 is in a BUS FREE state (i.e., not BSY) in operation 510 exemplified by decision 512. If the far-side bus 332 is still BSY, this means the device causing the bus hang condition is located in either bus segment 312 or 314 because the BSY signal on the bus 332 has not been cleared. In this case, the host computer 302 causes the expander 304 to issue a far-side reset signal to reset the far-side bus segment 312 in operation 514 in a manner similar to resetting the near-side bus segment 310. On the other hand, if the far-side bus 332 is not BSY, the device that caused the bus hang condition was in the near-side segment 310, which has already been reset. Thus, the bus hang condition has been cleared. It should be noted that the resetting and segment isolation operations continue one bus segment after another for either until a far-side bus is determined to be in a BUS FREE state, at which time the expander exits reset isolation mode and the method terminates in operation 516.